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Bulletin

American Congress on SURVEYING and MAPPING

Vol. IV, No. 1 *January, 1944*

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AMERICAN CONGRESS ON SURVEYING AND MAPPING
Box 470, Benjamin Franklin Station
WASHINGTON 4, D. C.

AMERICAN CONGRESS ON SURVEYING AND MAPPING

President's Foreword

IN OCTOBER last there took place in the United States an event which probably will have far-reaching effects on government surveying and mapping activities throughout the Western Hemisphere, and which may ultimately directly affect other than government work. For the first time representatives of surveying and mapping agencies from the republics of South America met in conference with officials of the United States, Canada, and Mexico, and consulted on matters pertaining to geodetic surveys, aeronautical charts, and topographic maps, with special emphasis on standards, specifications, procedures, and equipment. The conference was called the "Consultation on Geodesy, Aeronautical Charts, and Topographic Maps."

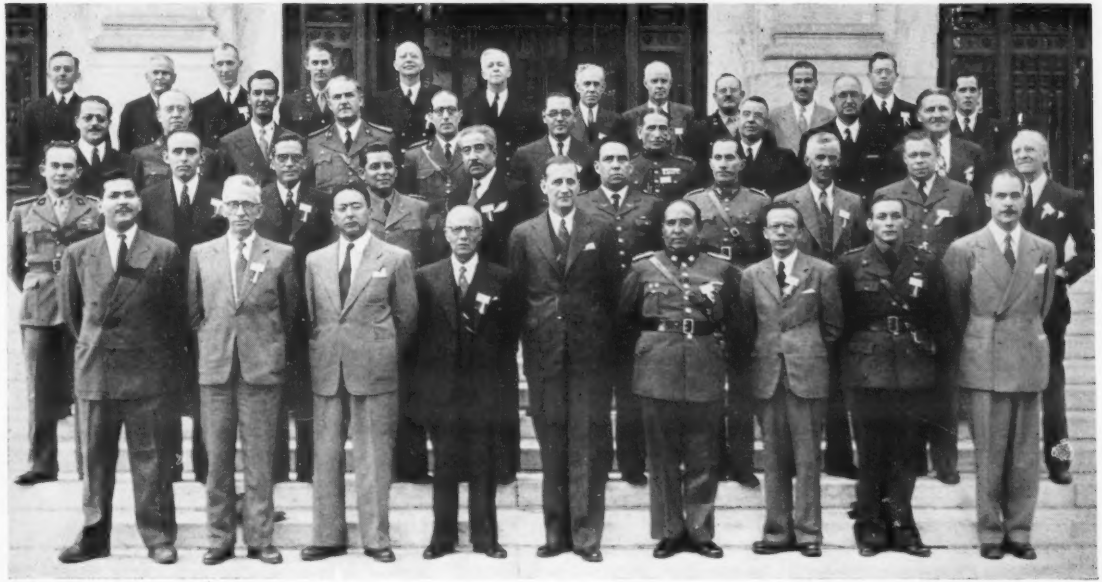
It is obvious that much good could result from such a Consultation and, in this observer's opinion, much good was accomplished. The American Congress on Surveying and Mapping is vitally interested in the objectives of the Consultation, as it is in all significant activities in the surveying and mapping profession. The fact that surveying and mapping is being considered on a hemispheric basis, of itself carries with it potentialities for the profession.

To keep its membership informed on the accomplishments of the Consultation to date, and to recognize the good will and understanding that characterized all of the technical sessions, the Congress is devoting most of the current issue of the BULLETIN to the Consultation. The story of the meetings, the recommendations agreed upon, the organizational set-ups perfected for the implementation of the recommendations, are given in the five articles immediately following.

From the American Congress on Surveying and Mapping, congratulations on the first Consultation—best wishes for future Consultations.

GEORGE D. WHITMORE

FIRST CONSULTATION ON CARTOGRAPHY



FRONT ROW: (left to right) Dr. Zarur of Brazil; Dr. de Mattos of Brazil; Dr. Abreu of Brazil; Ing. Pedro C. Sánchez of Mexico, Director, Pan American Institute, Geography and History; Mr. R. H. Randall of United States, Chairman, Commission on Cartography; Coronel Careaga L. of Bolivia; Dr. Ruiz of Colombia; Capitán Velasco of Colombia; Dr. Simonpietri, Secretary, Commission on Cartography. ★ SECOND ROW: Teniente Coronel Yegras of Paraguay; Ing. Alatorre of Mexico; Ing. Medina of Mexico; Teniente Coronel Abarca of Ecuador; Dr. Navarro of Ecuador; Capitán Conte Prado of Chile; Capitán Rojas of Chile; Mr. Chipman of Canada; Squadron Leader Burton of Canada; Mr. Peters of Canada. ★ THIRD ROW: Capitán de Corbeta Sánchez of Paraguay; Coronel Tamayo of Peru; Ing. Góngora of Peru; General Zubía of Uruguay; Mayor Mega of Uruguay; Dr. Vegas of Venezuela; Coronel Munilla of Cuba; Rear Admiral L. O. Colbert; Rear Admiral G. S. Bryan; Mr. Polling. ★ BACK ROW: Commander Chase; Lieut. Comdr. Green; Commander Adams; Lieut. Col. Cochran; Lieut. Comdr. Smith; Captain Garner; Mr. Pendleton; Mr. Wright; Major Hough; Mr. Suro; Mr. Hill; Mr. McClellan.

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Consultation on Cartography

ROBERT H. RANDALL, Chairman, Commission on Cartography,
Pan American Institute of Geography and History

THE United States is interested not only in basic surveys and maps of its own area, but also, as the members of this Congress can particularly well appreciate, in the progress of surveying and mapping in its neighbor nations. The consciousness of this interest is growing, especially in respect to the nations of the Western Hemisphere. For the kind of information that is embodied in maps—topographic maps, aeronautical charts, hydrographic charts, geologic maps, soil maps, cadastral maps, etc.—needed by one nation, is the kind that is needed by all. And the possession of such information is the best possible basis for the sort of mutual understanding between governments and peoples that is required for friendly and profitable association.

What are the standards for such fundamentally useful maps, which ought to be adopted by all of our neighbor nations so that there will be the highest practicable degree of quality and uniformity, and consequent facility in interchangeable use, as between nations? What are the best technical methods available for speeding up and maintaining a high rate of progress? What are the opportunities for international cooperation and collaboration in the actual making of surveys and maps, between adjoining and neighboring nations? In order to arrive at a beginning, at least, of the answers to such questions, a Consultation on Geodesy, Aeronautical Charts, and Topographic Maps has been held recently, under the joint sponsorship of the Commission on Cartography of the Pan American Institute of Geography and History and the American Geographical Society.

In Washington, D. C. and in Mexico City, from September 29 to October 21, members of the Commission on Cartography met, for the first time, in a series of open meetings with representative cartographers from all of the South American nations (excepting Argentina), and from Mexico, Canada, and the United States, to discuss the problems of geodetic surveys, aeronautical charts, and topographic maps.

BACKGROUND OF THE CONSULTATION

The Commission on Cartography was created by the Pan American Institute of Geography and History in the spring of 1941 at an assembly meeting of the Institute at Lima, Peru. This Institute is an official

THIRD ROW: Capitán de Corbeta Sánchez of Paraguay; ... Chipman of Canada; Squadron Leader Burton of Canada; Mr. Pedro de Polling; Mayor ... Vega of Uruguay; Dr. Vegas of Venezuela; Coronel Murilla of Colombia; Ing. Góngora of Peru; General Zubía of Ecuador. ★ BACK ROW: Commander Chase; Lieut. Comdr. Green; Commander Adams; Rear Admiral L. O. Colbert; Rear Admiral G. S. Bryan; Mr. Garner; Mr. Pendleton; Mr. Wright; Major Hough; Mr. Suro; Mr. Hill; Mr. McClellan; Lieut. Col. Cochran; Lieut. Comdr. Smith; Captain

organization set up and supported by the governments of the American republics on much the same lines as the Pan American Union. The general objectives of the Commission had been indicated in past resolutions of the Institute, and the Commission was established in order to implement these. As set forth in the resolution which created it, the Commission is "for the purpose of facilitating and expediting progress in map making in the nations of the Western Hemisphere, in accordance with their own map needs." The activities as set forth in this resolution include:

> Promulgation of standards for the various classes of maps needed in, and produced by, the various nations, to the end that uniform standards may be adopted;
>
> Provision for the regular exchange of information, as between the various nations, on their current mapping activities;
>
> Interchange of ideas and information, between the nations, on mapping activities proposed for each ensuing year;
>
> Regular exchange of information between the various nations on technical methods currently employed in all mapping operations;
>
> Provision for a similar exchange of information on methods in the experimental or developmental stages; and finally,
>
> The advancement of education and training in the science of map making by organizing courses in the universities and technical schools for advanced studies in the various methods that are employed in the production of maps; the exchange of professors and instructors for such courses; similar exchange of technical personnel between mapping agencies in the various nations, including exchange or assignment of junior personnel for in-service training.

Since the early part of 1942, when the Commission appointed a Secretary, Dr. André C. Simonpietri, and actually began on its program, it has been making a fact-finding survey or reconnaissance, in order to become thoroughly acquainted with the organization for mapping in each country, and to determine and record the status of the principal kinds of maps and surveys in each. This fact-finding survey is now substantially completed for the United States, Mexico, Venezuela, Colombia, Ecuador, Peru, Bolivia, and Brazil. Members to the Commission have been appointed from each of these except Bolivia and Brazil, in each of which appointments are understood to be under way.

The Consultation meetings in Washington were, as has been indicated, open sessions of the Commission. Those attending were the Commission members so far appointed, and other representative cartographers from the nations mentioned, and representatives of federal mapping and charting agencies of the United States. The mornings were devoted to informal discussions of the three principal topics, and in the afternoons inspection visits were made to the offices of the Army Air

Forces, the Coast and Geodetic Survey, the Geological Survey, the Army Map Service, the Hydrographic Office of the Navy, and the National Bureau of Standards.

On the social side the outstanding event in Washington was the reception and dinner given in honor of the Consultants. The Hon. Henry A. Wallace, Vice President of the United States, delivered the welcoming address. Other speakers were the Hon. Harold D. Smith, Director of the Budget; Dr. Pedro C. Sánchez, Director of the Pan American Institute; Mr. Roland L. Redmond, President of the American Geographical Society; and Dr. Isaiah Bowman, President of the Johns Hopkins University and the American Association for the Advancement of Science.

Recommendations of the Consultation

In their last meeting in Washington the Consultants made recommendations for the guidance of the Commission on Cartography. These included the establishment of three permanent committees, to be set up by the Commission to consider geodesy, aernonautical charts, and topographic maps. The full text of these recommendations is as follows:

"In respect to Geodesy, that:

I

The Commission on Cartography appoint a permanent Committee on Geodesy.

II

The Committee be empowered, under the auspices of the Pan American Institute of Geography and History, to act as a clearing house in the exchange of information and data concerning basic geodetic control surveys and related matters.

III

The Committee promulgate standards of accuracy and methods of procedure designed to serve the requirements of a strong triangulation net in each country and of a unified South American datum.

IV

Each participating country be urged to build up basic frameworks of triangulation and leveling designed to fit into a strong continuous continental network with adequate ties at the borders.

V

The Commission on Cartography and the Pan American Institute of Geography and History encourage the establishment of standardization facilities for instruments and equipment in the various countries.

VI

Meanwhile, where necessary facilities are not available, the Committee arrange for the standardization of instruments and equipment at the headquarters of the Institute in Mexico City, at the National Bureau of Standards, Washington, D. C., or at other established facilities.

VII

All participants be urged to make full use of the facilities afforded by the Commission on Cartography in all of the many phases of field and office process, to the end that the ultimate utility may be obtained from the total effort.

VIII

The Commission on Cartography, and its Committee on Geodesy recommended herein, meet annually, or at more frequent intervals if found in the interests of the participating countries to do so.

IX

In the interests of promoting this extremely important work, it is hoped that the respective nations of the Americas will give every possible aid to their mapping agencies in order that these recommendations may be put into effect without delay."

(Signed) The Temporary Committee on Geodesy:
Dr. Allyrio H. de Mattos, of Brazil
Mr. F. H. Peters, of Canada
Teniente Coronel Carlos Abarca, of Ecuador
Ing. Manuel Medina, of Mexico
General Eduardo Zubía, of Uruguay
Captain Clement L. Garner (Chairman), of United States

* * *

"In respect to Aeronautical Charts, that:

X

The Commission on Cartography appoint a permanent Committee on Aeronautical Charts.

XI

The Committee be empowered to act, within the rules of the Institute, in the consideration of all matters of cartography related to aeronautical charts.

XII

The Committee consider particularly the standardization of symbols, gradient tints, scales, projections, and other similar cartographic matters.

XIII

The Committee consider and recommend methods for the exchange of published charts.

XIV

Aeronautical authorities of American nations be urged to take all possible steps to utilize, to the fullest extent and at the earliest possible date, all facilities for obtaining aerial photographic reconnaissance adequate for small-scale aeronautical charts; especially, since relatively simple and easily obtained astronomic positions are adequate for this purpose.

XV

Aeronautical authorities be urged to produce complete series of aeronautical charts covering their respective nations at the earliest possible date.

XVI

The basic surveys for geodetic control and topographic maps be pressed in the respective nations with all possible speed in order that the aeronautical charts be perfected from the best basic data. But this urgent need for basic data should in no way retard the preliminary work of urgently needed aeronautical charts."

(Signed) The Temporary Committee on Aeronautical Charts:

Squadron Leader J. W. Burton, of Canada
Capitán de Bandada Francisco Conte Prado, of Chile
Capitán Alvaro Velasco, of Colombia
Teniente Coronel Miguel Angel Yegros, of Paraguay
Ing. Enrique Góngora, of Peru
Mayor Tomás R. Mega, of Uruguay
Lt. Comdr. Paul A. Smith (Co-Chairman), of United States
Lt. Col. Gerald FitzGerald (Chairman), of United States

* * *

"In respect to Topographic Maps, that:

XVII

The Commission on Cartography appoint a permanent Committee on Topographic Maps.

XVIII

This Committee be empowered under the auspices of the Institute to act as a clearing house in the exchange of information and data concerning topographic mapping and related matters in the Americas.

XIX

This Committee endeavor to establish standards of accuracy for various types and scales of maps.

XX

It use its influence to have adopted plans for the uniformity of map scales, sizes, and arrangements.

XXI

It lend its influence to the establishment and extension of geodetic data as a basis for cartographic control.

XXII

It urge the completion at the earliest opportunity of maps of small scale in order to enlarge geographic knowledge of unmapped regions.

XXIII

It urge the completion of maps at larger scales as rapidly as economic needs warrant and the completion of geodetic control will permit.

XXIV

The Institute use its influence to facilitate the purchase of the most modern surveying instruments and equipment and make general recommendations for the improvement in design of such instruments and equipment."

(Signed) The Temporary Committee on Topographic Maps:

Coronel Francisco Careaga L., of Bolivia
Dr. Silvio Froes Abreu, of Brazil
Capitán Eduardo Saavedra Rojas, of Chile
Dr. José Ignacio Ruiz, of Colombia
Capitán de Corbeta Jesús Blanco Sánchez, of Paraguay
Coronel José M. Tamayo, of Peru
Mr. Thomas P. Pendleton (Chairman), of United States

* * *

ITINERARY OF CONSULTANTS

The sessions in Washington were followed by a visit to the Aero Service Corporation in Philadelphia, where the visiting cartographers saw the Brock process of photogrammetric mapping; a visit to New York City as guests of the American Geographical Society, and a tour of inspection of the Fairchild Aerial Camera Corporation; and a visit to Rochester, N. Y., as guests of the Eastman Kodak Company and of the Bausch and Lomb Optical Company.

On their way back to their respective countries, the Latin-American contingent stopped at Knoxville, Tennessee, where they were guests of the Tennessee Valley Authority.

Following the sessions in the United States, two meetings of the Consultants were held at the headquarters of the Institute in Mexico City. The Commission on Cartography also met in that city and took action approving the recommendations of the Consultation.

Evidence of the desire to make these cartographic conferences a permanent feature of hemispheric planning lies in the fact that the consultants from Brazil extended an invitation for the Commission to participate in another Consultation, to be held in Rio de Janeiro in August 1944. By that time it is expected that the Commission will have finished its fact-finding survey. With the advantage of this detailed knowledge of surveying and mapping progress, organization, and personnel in all the American nations, and with the acquaintance which the Commission's members and the other cartographers who participated in the recent Consultation have developed, the proposed meeting in Brazil should do much to advance surveying and mapping progress in the Hemisphere.

Official Delegates

The official delegates attending the sessions were:

Pan American Institute of Geography and History: Ing. Pedro C. Sánchez, Director, Tacubaya, D. F. República Mexicana; Dr. André C. Simonpietri, Secretary, Commission on Cartography.

Bolivia: Coronel Francisco Careaga L., Director, Instituto Geográfico Militar.

Brazil: Dr. Allyrio Hugueney de Mattos, Director Técnico, Conselho Nacional de Geografía; Dr. Silvio Froes Abreu, Conselho Nacional de Geografía.

Canada: Squadron Leader J. W. Burton, Deputy Director of Intelligence (Mapping), Royal Canadian Air Force Headquarters; Mr. K. G. Chipman, Chief Topographical Engineer, Ministry of Mines and Resources; Mr. F. H. Peters, Surveyor General and Chief of Hydrographic Service, Ministry of Mines and Resources.

Chile: Capitán Eduardo Saavedra Rojas, Oficial Técnico de Geodesia y Topografía, Instituto Geográfico Militar; Capitán de Bandada Francisco Conte Prado, Jefe, Sección de Fotogrametría de la Fuerza Aérea.

Colombia: Dr. José Ignacio Ruiz, Jefe, Departamento Topográfico, Instituto Geográfico Militar y Catastral; Capitán Alvaro Velasco, Departamento Fotogramétrico, Instituto Geográfico Militar y Catastral.

Ecuador: Dr. José Gabriel Navarro, Presidente, Comisión Ecuatoriana Demarcadora de Límites con el Perú; Teniente Coronel Carlos Abarca, Director, Servicio Geográfico Militar.

Mexico: Ing. Manuel Medina, Jefe, Oficina de Geografía Dirección de Geografía, Meterología e Hidrología, Ministerio de Agricultura y Fomento; Ing. Alfonso Vaca Alatorre, Comisión Geográfica Militar, Dirección de Ingenieros.

Paraguay: Teniente Coronel Miguel Angel Yegros, Comandante, Cuerpo Nacional de Zapadores del Paraguay, Ejército; Capitán de Corbeta Jesús Blanco Sánchez, Director de Hidrografía y Navegación de la Armada.

Peru: Coronel José M. Tamayo, Miembro Fundador del Servicio Geográfico del Ejército del Perú; Ing. Enrique Góngora, subdirector, Servicio Aerofotográfico Nacional.

United States: Ing. Robert H. Randall, Chief Examiner, Surveying and Mapping, Bureau of the Budget, Executive Office of the President, Washington, D. C.

Uruguay: General Eduardo Zubía, Director, Instituto Geográfico Militar; Mayor Tomás R. Mega, Jefe del Estado Mayor de la Aeronáutica Militar.

Venezuela: Dr. Luis Felipe Vegas, Jefe, Sección Geodésica, Dirección de Cartografía Nacional.

AIR TRAVEL IN 1948

THE FOLLOWING tentative flying schedule for 1948 is being displayed by Pan American Airways at the New York Museum of Modern Art. Assuming that planes will travel great circle routes at speeds of 250 miles an hour, the schedule forecasts:

From New York to:	*Hours in Flight*	*Round Trip Fare*	*From New York to:*	*Hours in Flight*	*Round Trip Fare*
Bermuda	2:40	$ 37.26	Moscow	19:12	$259.20
Mexico City	8:12	110.70	Honolulu	20:12	272.70
London	13:48	186.30	Bombay	32:00	432.00
Paris	15:00	202.50	Sydney, Australia	42:00	567.00
Rio de Janeiro	19:00	256.50	Hong Kong	44:00	594.00

Geodetic Operations in the Americas

CAPTAIN C. L. GARNER, U. S. Coast and Geodetic Survey

GEODETIC control surveys in the Americas, and related matters, were discussed at two sessions of the Consultation on Geodesy, Aeronautical Charts, and Topographic Maps. The discussions covered the extent of the various geodetic operations in the countries of South America and their initial datums, and, in particular, referred to the question of South American cooperation in the adoption of uniform standards for surveys so that, when the work of the different countries is joined together, it will form a consistent whole and fit into a single datum for the continent.

The reports on existing surveys indicated that in only a few countries had geodetic control been extended to their respective boundaries and this control, of necessity, was based on a provisional datum in each country. Some countries use the Clarke spheroid of reference but the majority use the International spheroid. Progress of the triangulation and leveling and other geodetic operations varies greatly although some work has been done in each country. Some changes in the adjustments of the data are almost obligatory as it is obvious that the junctures of field work based on different datums at boundaries would result in bothersome differences under present conditions.

The discussions by the Consultants evidenced the realization of the vastness of this project of continental scope. At the same time it was acknowledged that the ultimate goal could not be attained except through cooperative action. In any event, nothing is lost by the proposed method of approach since the early operations in any country of necessity are based on provisional datums, and where operations are uniform, the surveys can be easily coordinated at boundaries at the opportune time.

The North American datum, jointly adopted by Canada, Mexico, and the United States in 1913, was cited as an excellent example of similar cooperation where practically an entire continent is coordinated under a single datum. Obviously this effects simplification and saves much expense in the production of maps and geographic data, particularly at boundaries.

The discussion also brought out the realization of the great importance of geodetic control in coordinating all classes of projects having to do with mapping, flood control, reclamation, irrigation, and many other engineering activities. The geodetic process also provides data essential for geophysical explorations of great importance to many scien-

tific undertakings such as the study of earth movements due to earthquakes or other causes. It was pointed out that in Mexico triangulation is now being extended eastward from the 98th meridian triangulation in that country to Guatemala for use in the Guatemala-Honduras boundary delimitation.

Although there were no commitments as to future action by the Consultants, there was much favorable comment on the idea of establishing a central office, under the auspices of the Commission on Cartography of the Pan American Institute of Geography and History, to act as a clearing house for the cooperation necessary to insure standardization and coordination of surveys in various countries.

The Pan American Institute of Georgraphy and History informed the delegates of its desire to assist with the facilities of its Office and offered the use of its standardization equipment for certain types of instruments.

To further advance geodetic work in the Americas, a Temporary Committee on Geodesy was formed to consider appropriate recommendations.[1]

●

FAMOUS SURVEYING INSTRUMENT

One of the most interesting items unearthed by the Committee on Historical Instruments of the Los Angeles Section is an old transit which was used by George Washington in surveying parts of the Virginia wilderness for Lord Fairfax.

This instrument has been in the possession of the O'Neill family for more than one hundred and twenty-five years and recently came into the possession of Lewis R. O'Neill of Long Beach, California, through the death of an older brother.

The transit is probably one of the earliest of its type ever used in America. Its pattern and figures are engraved and bears the name of the maker "B. Chandee, Nottingham, Eng." The case which is made of chestnut is very light in weight, and there still remains clinging on the inside bits of the velvet lining with which it was originally padded. The instrument is still in perfect condition and, although crudely made, is said to be fairly accurate.

H. R. SAUNDERS

[1] For personnel of this Committee and Recommendations adopted see page 6.

Aeronautical Charts in an Air Age

Lieut. Colonel Gerald FitzGerald, U. S. Army Air Forces

AERONAUTICAL charting, of prime importance in the present Air Age, was the subject for discussion at three sessions of the Consultation on Geodesy, Aeronautical Charts, and Topographic Maps. The writer, as Chief of the Aeronautical Chart Service of the U. S. Army Air Forces, was appointed to lead the discussion on aeronautical charts. He emphasized aviation and said, "We believe that by thoroughly discussing the over-all problems of hemispheric mapping we will all derive much in the way of practical help." It was made clear that the discussions were for the purpose of becoming acquainted with the specific problems of each country and of the plans that each nation has for their solution.

The visiting Consultants informally outlined their respective aeronautical charting programs and the objectives of their respective countries. Some of the countries have already instituted charting programs while others have such programs under consideration. Most of the countries represented are using topographic maps as a base for aerial navigation. Representative samples of charts produced as aeronautical charts and topographic maps used for aerial navigation were exhibited by the various Consultants.

Symbols and other characteristics of aeronautical charts were discussed and it was generally agreed that uniform standards and specifications for all charts produced by countries in the Western Hemisphere would greatly benefit all American nations. Specimen copies of maps and charts produced by Canada and the United States will be distributed to the Consultants from each country through the Pan American Institute of Geography and History.

Opinion prevails that all maps and charts produced, covering territory in the Western Hemisphere, should be submitted to the countries they cover for review and correction. In this way a more certain check can be made to assure accuracy of detail in published maps and charts.

United States Aeronautical Charts

To define what is meant in the United States by the term, "Aeronautical Charts," various series of charts produced in this country were described and exhibited. It was pointed out that prior to the present conflict all aeronautical charts for civil use and those used by the Army Air Forces were prepared and published by the United States Coast and

Geodetic Survey. These consisted of Sectional Charts at a scale of 1:500,000, Regional Charts at a scale of 1:1,000,000, Radio Direction Finding Charts at a scale of 1:2,000,000, and a Planning Chart of the United States at a scale of 1:5,000,000, all constructed on the Lambert conformal conic projection. To a large extent, the Army Air Forces program is based on the preliminary research and study carried on by the Coast and Geodetic Survey for some years, and the full facilities of this and other map-producing agencies in the United States are being used by the Army Air Forces in its present program.

At the war's beginning, when Army Air Forces transport pilots were called upon to fly over various parts of the Western Hemisphere and other regions of the world, there was very little available information and very few maps and charts for the pilots. Consequently many airplanes were lost in flight operations. To produce as quickly as possible the maps and charts so sorely needed for aerial navigation, every available source of information was tapped and used in the preparation of the first editions. As aerial photography was accomplished and other new information became available, subsequent corrected editions were published. In this way maps and charts have been kept current and up to date.

Army Air Forces Charts

The Aeronautical Chart Series of the Army Air Forces might be considered in two main categories; namely, PLANNING CHARTS and OPERATIONAL CHARTS. Planning Charts are divided into World Planning, Group Planning, and Regional. Operational Charts include Long Range Air Navagation Charts, General Pilotage Charts, Approach Charts, and Target Charts. At the start of the war each of these types of charts was laid out in series to cover the entire world.

The PLANNING CHARTS are constructed on the Lambert conformal conic projection at a scale of 1:5,000,000. These charts contain the locations of cities and principal airports. Preliminary editions were produced showing relief by contours only, but are now revised to show relief by gradient tints.

Charts of the World Outline Series are printed in two colors and show drainage and a few important cities. These charts are based on the same layout, projection, and scale as the Planning Charts.

The LONG RANGE AIR NAVIGATION CHARTS, for use in celestial navigation, are published at a scale of 1:3,000,000 and are compiled on a Mercator projection with true scale at the middle latitude of each chart. These charts contain only essential navigation data, cities, and primary railroads. The charts are now being produced to show altitude by gradient tints.

PILOTAGE CHARTS, for use in contact flying are produced in a coordinated world series at a scale of 1:1,000,000 based on the Lambert conformal conic projection, except that the Mercator projection is used between 4° north latitude and 4° south latitude, and the polar stereographic projection for latitudes over 72°. The layout for this coordinated series of charts also forms a basic index for the 1:500,000 Pilotage Charts and the 1:250,000 Approach Charts produced for more detailed information. There are 1,172 charts of the 1:1,000,000 scale series covering the land areas of the world. Of these more than 950 have been published. All charts of the 1:1,000,000, 1:500,000, and 1:250,000 series have a standard size of 22 by 29 inches.

APPROACH CHARTS are published at the same size and to the same general specifications as the 1:1,000,000 scale charts. These charts cover in more detail such locations as highly developed industrial centers and strategic areas, including important islands.

TARGET CHARTS are produced at a scale of approximately 1:125,000. Some of these charts are published in the United States while others are produced by field units in the various theaters of war. Printed on the reverse side is a larger scale detail showing the target objective.

In addition, Special Charts of designated coverage and scale for long range navigation, Flight Charts developed for flying designated routes, and other maps required for Army Air Forces operations are produced under the direction of the Aeronautical Chart Service.

From time to time it is necessary to revise specifications for charts to meet changing military requirements. The Air Forces pilots tell the Aeronautical Chart Service what they want and must have to operate over routes in various parts of the world. The main objective of the Aeronautical Chart Service is to provide good charts here in the United States for training pilots; then to supply as nearly as possible the same kind of charts for other parts of the world where they will have to operate.

Navy Charts

Charts constructed to meet the requirements of the United States Navy were exhibited. All these charts are produced on the Mercator projection and vary in some detail as to color and size from those produced for the Army Air Forces, although the scales used for each purpose are comparable.

PLANNING CHARTS, at a scale of 1:5,000,000, designated as the V-70 Series, are produced for the purpose of facilitating the planning of long range flights as well as joint air and surface operations. The series number identifies the scale as being 70 nautical miles to the inch. Charts

of this type are produced for the Navy only of areas selected in accordance with their strategic convenience.

The AIR NAVIGATION V-30 SERIES, scale 30 nautical miles to the inch, is used for celestial, radio, and some contact navigation.

The CONTACT NAVIGATION SERIES which correspond to the Regional and Sectional Charts of the United States are designated as the V-14 and V-7 Series produced at a scale of 14 and 7 nautical miles respectively to the inch.

The LOW VISIBILITY CONTACT NAVIGATION CHARTS, known as the V-3 Series, contain more detailed information, and are used when such detail is necessary because of bad weather.

The LANDING AND APPROACH CHARTS are produced at scales ranging from ½ mile to 3 miles to the inch.

BOMBING OBJECTIVE CHARTS are on the same scale as the Landing and Approach Charts.

In addition to charts, the Hydrographic Office of the Navy produces a manual which is known as the Naval Air Pilot, and the Army Air Forces produces Airport Directories. These manuals contain more detailed aeronautical data.

It is felt that there was a better understanding of the term, "Aeronautical Charts," after these discussions and exhibits. Mr. Randall, in closing the session on Aeronautical Charts, stated that in exhibiting these charts we wanted it understood that we believed they were representative of a number of mistakes we had made rather than something we should be particularly proud of. He said, "We may be in the position of a man who is shoved off the end of the dock into deep water without having any knowledge of how to swim. Because we have splashed around and have not been drowned does not indicate that we are in a position to teach swimming."

TRI-METROGON MAPPING

The application of tri-metrogon photography to aeronautical charting was one of the high lights of the discussions and exhibits. The various phases of photogrammetric compilation with respect to tri-metrogon photographs were inspected and the amazing accomplishments both in aerial photographic coverage and in compilation were illustrated. Collaboration between the United States and various countries of the Western Hemisphere has resulted in millions of square miles being photographed and compiled. All Consultants were enthusiastic over this means of compilation, particularly for aeronautical charts, and were desirous of greater development along this line in their respective countries.

Recommendations of the Consultation

To further the objectives of the Consultation, a Temporary Committee on Aeronautical Charts was formed to consider appropriate recommendations.[1]

There can be no doubt that air transport will benefit by maps and charts containing no erroneous information. To achieve this perfection there is clearly a need for technical discussion among makers of surveys, maps, and charts. Such cooperation will result in the production of the kind of charts that should facilitate the freest possible use of air transport. It might also assist in the development of a hemispheric language of charts which would make maps and charts produced by any American nation useable to the maximum degree by all.

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WAR DEPARTMENT SEEKS FOREIGN MAPS

THE War Department, Army Map Service, is seeking maps, city plans, port plans, place name lexicons, gazeteers, guide books, geographic journals, and geologic bulletins covering all foreign areas outside the continental limits of the United States and Canada. Of particular interest are maps and guide books purchased within the last 10 years, including maps issued by the U. S. Government and the National Geographic Society.

The public is asked to donate this material or lend it to the War Department for the duration, or long enough for reproductions to be made. Franked labels will be forwarded to donors.

It is important to indicate what is not wanted. Maps should be mailed to Miss Viohla Klipell, Head of New York Library Branch, Army Map Service, 1270 6th Ave., New York 20, N. Y.—*Aero Digest,* November, 1943.

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MAPS

"In a map one may journey over all the universe, without the expense and fatigue of traveling, without suffering the inconveniences of heat, cold, hunger, and thirst."

—Cervantes in Don Quixote

[1] For personnel of this Committee and Recommendations adopted see page 7.

Topographic Mapping in the Americas

THOMAS P. PENDLETON, U. S. Geological Survey

THE subject of topographic mapping in the Americas was discussed at two very interesting meetings of the Consultation on Goedesy, Aeronautical Charts, and Topographic Maps. The full report on these meetings is long, because the prevailing atmosphere of friendly enthusiasm kept the exchanges of information moving at a rapid rate. The writer was designated to lead the discussion and he called upon the individual Consultants from time to time in order that all might have an opportunity to speak. The efficiency of the interpreters, and the fact that a number of the Consultants present could speak and understand both Spanish and English, made all details of the discussion fully understandable to everyone.

Considerable attention was given to the scales and contour intervals used by the several nations in making their official topographic maps. It was interesting to note that each nation indicated the need of maps upon different scales to adequately serve a variety of purposes. Thus, it appears usual to have maps of two or three or more series for the official maps of a country; a large-scale series for industrial regions and settled areas, a medium-scale series for general purposes, and often a small-scale series for a geographic representation of large areas. Such scales as 1:20,000; 1:31,680; 1:25,000; 1:50,000; 1:62,500; and 1:1,000,000 were most frequently mentioned.

The percentage of areas mapped was generally indicated. It was apparent that a great deal remains to be done in order to complete the planned mapping, particularly for the series of larger-scale maps. In several of the represented nations there are laws that hold the responsibility for general mapping to a single designated agency. In others, the maps are produced from information gathered from many different sources. In Brazil, a law has been passed making it compulsory for all municipalities to produce maps of their individual areas; these are subsequently assembled by a central agency and furnish a very great quantity of geographic information.

The discussions indicated a very strong dependence upon photogrammetry in mapping methods. In fact, it was repeatedly stated that good maps of the vast jungle areas and unsettled regions would be almost impossible to obtain without the use of photographs taken from the air. Many of the Consultants mentioned the unfortunate lack of modern photogrammetric equipment. In some instances the national mapping programs are being planned to concentrate first upon control surveys and

aerial photography, leaving the compilation of maps from the photographs for a later time when proper plotting equipment may become available. Dr. Simonpietri, the Secretary of the Commission on Cartography of the Pan American Institute of Geography and History, reported that his observations in various countries in South America disclosed the use of the aerocartograph, the stereoplanograph, and the multiplex equipment. He said the multiplex generally seemed to be the most satisfactory instrument.

Some time was given to describing the mapping activities of the United States, as conducted by the Geological Survey, the Coast & Geodetic Survey, the War Department, the Soil Conservation Service, the Forest Service, and other Bureaus.

Further discussion related to standards of map accuracy and to uniformity in map symbols. The Consultants were generally in favor of reaching agreements in these matters, in order that the difference in form of maps will not be unnecessarily great.

To develop a common understanding and to provide for continued exchange of useful information, a Temporary Committee on Topographic Maps was formed to consider appropriate recommendations.[1]

It was clear that the sessions were regarded as eminently successful. The Consultants brought together the best knowledge on topographic mapping from both of the Americas. Many valuable contacts were made and all Consultants seemed enthusiastic in their estimate of the progress achieved in the general plans for mapping in the Western Hemisphere.

NEW POPULATION MAP

A NEW POPULATION MAP of the United States has been published recently by the Bureau of the Census based on the 1940 Census. It is in two sheets and shows the population density by minor civil divisions. The map is constructed on the Albers conical equal-area projection at a scale of 1:2,500,000 (1 inch=40 miles, approximately). It is obtainable from the Government Printing Office, Washington, D. C., at a cost of 40 cents.

[1] For personnel of this Committee and Recommendations adopted see page 8.

Cartography in Brazil

Dr. Allyrio H. de Mattos, Director Técnico,
Conselho Nacional de Geografia

THE Brazilian relief has been described. in a general way, by Professor Fabio Macedo Soares Guimarães, head of the Department of Geographical Studies of the Conselho Nacional de Geografia in a recent article published in Number 4 of the "Boletim Geográfico."

In general terms, Brazil can be "characterized in a few words: a plateau in the form of stairs surrounded by sedimentary plains."

The Terrain

Brazil is not a country of high mountains; no altitude reaches 9,000 feet. The areal distribution of the altitudes shows that 3 percent of the national territory is above 2,700 feet, while the lowlands with an altitude lower than 600 feet make up 40 percent of the total area. Thus 57 percent of the area of Brazil has an altitude of between 600 and 2,700 feet.

Brazil has three different plains: the Amazonic plain, the plain of Paraguay-Paraná, and the coastal lowlands. The plateau forms two groups: the Planalto Guiano at the north of the Amazonic plain, and the Planalto Brasileiro with a larger area surrounded by the three plains mentioned above.

The Brazilian relief is more of the plateau type than of the serras type. The ridges generally called serras are actually slopes of the plateau and the tablelands. They are not elevations with steep slopes on both sides although, from a lower level, the observer gets the impression of serras. After climbing these slopes one comes to a plateau with an even relief and a gentle inclination.

In relation to the altitude, the Brazilian plateau presents the following characteristics: the higher elevations are to the east and relatively near to the ocean, while the altitudes get lower towards the north and west. To the northwest, however, the plateau does not descend continuously, but before each descending stairs comes a higher step which starts to descend again. Finally, to get to the plain, it is necessary to climb several times. It is a succession of "cuestas."

Geographically and geologically, the Brazilian plateau can be divided thus:

The eastern serras
The peneplains of the northeast
The peneplains of the central east

The southern stairs
The central scarp and tableland

The eastern serras formed by two main chains and almost parallel to the coast, are composed of crystalline rocks and are conspicuously located between parallels 17° and 27° south latitude. To the north and south it gets lower. Thus the region around the top of the serra has an undulated surface. The first step of the plateau, made by the serra, is called Serra do Mar and it looks like a wall separating the interior from the coast. Then comes the second step, almost parallel to the Serra do Mar, the Serra da Mantiqueira, where the highest elevations are found—Pico da Bandeira with an elevation of 8,670 feet and Pico do Itatiaia with an elevation of 8,361 feet. All other serras, which are smaller, are scattered over the Brazilian territory and form the water divide of the Amazon River basin.

The Population of Brazil

The census of 1940 shows that Brazil has a population of 41,565,000. For 1944, the authorized estimate is 43,000,000 inhabitants. The Indian population was not included in the 1940 Census but it is estimated to be around 700,000. The greater part of the population is located along the coast in isolated clusters, the most dense clusters being located around Rio de Janeiro and São Paulo. The interior and the Amazon basin are sparsely settled.

General Condition of the Cartography

The agencies in charge of the cartographic work in Brazil, according to the chronological order of their establishment are:

(a) Serviço Geográfico e Histórico do Exército
(b) Departamento Hidrográfico da Marinha
(c) Departamento Geográfico de Minas Gerais
(d) Departamento Geográfico e Geológico de São Paulo
(e) Inspetoria Federal de Obras Contra as Secas
(f) Conselho Nacional de Geografia.

Besides these agencies there are others, with a more restricted aim, making maps for special purposes.

(a) The Serviço Geográfico e Histórico do Exército started its work with the survey of South Brazil. It executed the triangulation of part

of the Rio Grande do Sul and published several topographic maps at a scale of 1:100,000. Sometime later it introduced the use of land and aerial photogrammetry and has already surveyed some important areas and published maps at the scale of 1:50,000. At present, this agency is surveying intensely the region important to the national defense. Several of its maps are considered "restricted" and have not been published. The use of photogrammetry is general but the methods of restitution are many; however, the *Wolf* stereographic system is the dominant method.

(b) The Departamento Hidrogràfico da Marinha is in charge of surveying the coast and the water area. It does coastal triangulation and also uses aerial photogrammetry methods. Its work is continuous and its production is large and reliable. Several navigation charts have been published.

(c) The Departamento Geográfico de Minas Gerais is a State agency and is interested exclusively in surveying the State of Minas Gerais. It has been in existence for several years, and has completed the triangulation of about one-third of the State. This agency has not yet introduced aerial photogrammetry. Topographic mapping is done mostly by means of rapid surveys using compass, pedometer, and barometer. In the more important regions, more precise methods are used. Forty maps, at 1:100,000 scale, have already been published, each map covering a quadrangle ½ degree by ½ degree. The Departamento has also surveyed the State boundary lines, and has made county maps as requested.

(d) The Departamento Geográfico e Geológico do Estado de São Paulo is also a State agency and is interested only in the surveying of the State. It has made many triangulations together with non-precise topographic surveys. At present, it is using closed stadia traverses and aerial photogrammetry methods. The Departamento also started precise leveling and has already completed several hundred kilometers of leveling along the most important roads. Maps at the scale of 1:100,000 covering a quadrangle ½ degree by ½ degree have been published. Besides this work, it has carried on other projects in the region when there was an urgent need for maps, and has also worked on the municipal maps of the State.

(e) The Inspetoria Federal de Obras Contra as Secas (I.F.O.C.S.) is in charge of public works in the northeast. The area is large and the lack of maps has handicapped its efficiency. At first, its activity was concentrated on small-scale maps. Later, astronomic stations were established. Some rapid surveys were also made. Where reservoirs and roads were to be built, precision surveys were made. Thus in a score

of years, the I.F.O.C.S. has been able to make reliable small-scale maps covering a considerable area of the northeast.

Today the I.F.O.C.S. is using aerial photogrammetry methods, making restitution with the multiplex equipment. This useful instrument is being used with great efficiency. The survey of part of the lower São Francisco River can be cited as a model survey in which modern techniques were used.

It should be noted that aerial photogrammetry in Brazil has not reached the expected development because of the high cost of the instruments, and because there is failure to understand the urgent need of going forward with the country's survey using more precise methods.

(f) The Conselho Nacional de Geografia is the newest agency. It was created for the purpose of developing geographic studies. In the beginning, its program did not include field work. The census project for 1940, as well as the development of the statistical services, showed clearly the lack of good maps.

In 1939 the Instituto Brasileiro de Geografia e Estatística was created and divided into two branches: The Conselho Nacional de Geografia and the Conselho Nacional de Estatística. These two organizations work in close cooperation.

To supply the necessary maps for the general census of 1940, a decree was issued (No. 311) making it compulsory on every municipality to prepare a map of its territory. The specifications for these maps were very modest because it was impossible for the majority of the municipalities to obtain technical personnel and funds to make good surveys.

At the time of this decree a campaign for *coordenadas geográficas* (astronomic coordinates) was started. The aim was to determine with precision the position of each city in the country. This campaign started in November 1939 and bore magnificent results. However, it also emphasized the need for supplementary work because it brought out the errors in the existing maps. Answering this challenge, several campaigns were carried on in many states of Brazil for better methods of surveying. Everyone feels the urgency of changing the existing methods so as to increase the accuracy of the work and avoid past mistakes.

Thus, the Conselho Nacional de Geografia which originally was only to compile a new map of Brazil at a scale of 1:1,000,000, now directed a good part of its activity to the correction of errors. The errors found are the reasons for its wider scope. From an office map compiler, the Conselho Nacional de Geografia has become an important map surveyor. God bless those errors!

At this writing it is impossible to give details of the program of the Conselho Nacional de Geografia, which has to be approved by the Central Directory of the Conselho; but it can be stated that the plans for 1944 are very much expanded over those of 1943.

Present Problems

The problem of surveying and mapping in Brazil is, in general, a complex one. In the first place, one has to consider the large area and the low population. As a result of this there is a lack of good roads. The character of the terrain and the thick vegetation makes movement very difficult. These regions are also subject to diseases.

Secondly, there is a lack of sufficient funds to carry on surveys. These projects are expensive and the Government is not encouraged to make a substantial appropriation for cartographic work of no immediate use. Many people still think that a simple reconnaissance map is enough. However, this attitude is changing and the Government is making larger appropriations. It is hoped that in the near future the outlook will be even more favorable.

Conclusions

The first thing which we believe necessary is to promote a closer cooperation between the several agencies, giving coordination to their works so as to avoid unnecessary duplication. Fortunately, the Conselho Nacional de Geografia, the agency in charge of collecting information and maps from all of Brazil, started this needed coordination, so that no one starts a project now without first inquiring of the Conselho whether or not a similar project is in progress.

Second, we should place a high emphasis on the standardization of methods. It is important to have a description of the method used and the instrumental specifications in order that the user may know the grade of accuracy of the survey.

In relation to the actual projects, a basic first-order triangulation net is necessary which would be the basis for other triangulations and topographic surveys. Thus far, the existing triangulations are independent and not adequately controlled or adjusted. None are good enough to be the fundamental structure. There is no first-order net, in any region, in spite of the fact that our triangulation is already over one-half million square kilometers.

Besides the above projects, a gravimetric survey is also important for studies of the deflection of the vertical.

In respect to topographic surveys for cartographic purposes, we

believe it necessary to increase the use of aerial photogrammetry methods, which are used very little as compared to the ordinary methods.

During our recent visit to the United States, in connection with the Consultation on Geodesy, Aeronautical Charts, and Topographic Maps, our attention was called to the use of tri-metrogon methods in the mapping of Alaska and certain regions of South America. This method, we think, could be used economically in many areas of Brazil without good geodetic control and would be sufficiently accurate for making some of the smaller-scale maps. In the most important regions the multiplex should be used.

Unfortunately, at the present time, the war does not permit the importation of the necessary instruments. While we are waiting for better times, the only thing to do is to go ahead and use the small amount of material which we have.

INK AND WAR

MORE THAN ANY other fight in history, this is a war of printer's ink. Inks which will print on metal and not wash off in water nor soak off in oil, are still military secrets, but more than one soldier, taking a military machine apart in the field and lamenting the loss of his repair manual, will find hints, diagrams, and even full instructions right on the surfaces which he uncovers as he removes the bolts.

Luminous inks for night fighting were used only for watch dials in the last war; they serve now on all sorts of instrument faces and other devices.

Fluorescent inks, which will show up only in light waves invisible to the naked eye, are useful to military devices but like the luminous ones will serve post-victory industry in all sorts of places in which ordinary light either is damaging to the product or is difficult to apply.

Perhaps the strangest development is the printing of fine "reticule" lines on the lenses used in gun sights for war and in surveyors' instruments in peace. Formerly spider webs were the only materials fine enough to be used for these reticules, but when not enough spiders could be found to fight this war a way of printing these lines was worked out. The printed lines are more uniform than the spider webs and much easier to handle on the production line. And this development of the printer's craft will reduce the costs of thousands of types of industrial and other instruments during the oncoming peace.—*Scientific American*, December, 1943.

CHARTS

By J. Tilden Silver*

The gain in weight of baby, and the many tons of steel,
The high and low of stocks and bonds on fickle fortune's wheel,
The mighty rushing rivers, and the storm or vagrant breeze,
The heights of misty mountains, and the deeps of surging seas,
The tremors of the earth below, the drumbeat of your heart,
And the rising tide of empire, we plot upon a chart.

The rhumb line sailed by mariners who bring us safe to port,
The coastline with its reefs and shoals, the naval base and fort,
The wireless beam for pilots in the fog and blinding snow,
The beacon's cheerful signal, and the airport's welcome glow,
The tremors of the earth below, the drumbeat of your heart,
And marvels that seem commonplace, we plot upon a chart.

The structure of an atom, and the score of any tune,
The path of Halley's comet, and the orbit of the moon,
The steam and hydro power plants, and the wheat and cotton crop,
The soldier boys and sailor lads from office, farm, and shop,
The tremors of the earth below, the drumbeat of your heart,
The epic tales of all mankind, we plot upon a chart.

The nation's parks and playgrounds, its forests, pine and birch,
The bounds of town and hamlet, and the village green and church,
The resting place of loved ones, and the schoolhouse on the hill,
The swimming hole, the rustic bridge, the tavern by the mill,
The tremors of the earth below, the drumbeat of your heart,
Life's greatest joys and sorrows, we plot upon a chart.

L'envoi:

Our life is like a simple graph, with points so placed to show
Good deeds above an axis line, ignoble acts below;
And when the final line is drawn, in shanty or in palace,
If we have dodged the pitfalls of envy, fear, and malice,
If we have wisely looked beyond, and based our life on love,
We will find our earthly record on the master chart above.

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* Chief, Maps and Drafting Section, Federal Power Commission. Poem was dedicated to Mr. Basil Manly on the occasion of his third appointment as Federal Power Commissioner.

Federal Surveying and Mapping Agencies

This is another in the series of sketches of the history, purpose, and scope of activities of federal agencies engaged in surveying and mapping.—EDITOR.

BUREAU OF PLANT INDUSTRY*

(Division of Soil Survey)

DEPARTMENT OF AGRICULTURE

A SOIL map is made by delineating the patterns of soil types, defined in accordance with the characteristics important to growing plants and farming practices, upon an accurate base map. The definition of each soil type and subtype (or phase) shown on the map is established through research in the field, and its responsiveness to management is learned through field and laboratory research, and by the observation of the experience of farmers. Thus, a carefully prepared explanatory text must accompany each soil map.

HISTORICAL

Soil surveying was begun in the Department of Agriculture in 1899 as an integral part of a soil research program.[1] It has continued to the present time in cooperation with the State Agricultural Experiment Stations. During this period over 1,600 soil maps have been printed. Currently, about 25 maps and reports, involving a total area of some 15,000 square miles are published each year. As the research has developed, techniques for soil investigation, classification, and mapping, and for the interpretation of the results, have vastly improved.[2] The mapping has increased in detail. Older maps were published at scales of one-half to one inch to the mile, while modern maps are published at scales

* Prepared in the Office of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

[1] The work was begun in the Division of Soils, a former unit of the Department of Agriculture. On July 1, 1901 the Division of Soils was reorganized as a part of the Bureau of Soils, and on July 1, 1927, the Division was placed in the newly organized Bureau of Chemistry and Soils. On October 16, 1938, the Division of Soil Survey was transferred to the Bureau of Plant Industry, Soils, and Agricultural Engineering.

[2] The technical methods of making soil maps are described in *Soil Survey Manual*, U. S. Department of Agriculture Misc. Pub. No. 274, 136 pp. illus., 1937.

between 1 and 2.6 inches to the mile, depending upon the nature of the landscape and of the agricultural problems to be solved. Most field mapping is done now with the aid of aerial photographs. During the years, the fundamental purpose of the research has remained the same—to provide an accurate scientific basis for planning the optimum use and management of rural lands—but the accuracy and completeness of the work has increased. Also, as agriculture changes there are new crops, new fertilizers, new machinery, and new problems to be dealt with. These changes require continual re-interpretation of the potentialities and uses of the soil types.

Cooperative Survey Program

In the cooperative soil survey program, the Division of Soil Survey has devoted much attention to the development and maintenance of a uniform system of soil classification and nomenclature so that each of the thousands of soil types in the country has a proper place in the system and is everywhere called by the same name. To maintain accuracy and usefulness the system must undergo continual growth and improvement as new knowledge becomes available. This work is an essential part of the general program of soil research in the Department and in the State Agricultural Experiment Stations. Soil definitions and classification cannot be standardized in a strict engineering sense—at least not so long as new agricultural problems are arising and new scientific knowledge is rapidly becoming available.

A Modern Soil Map

During the past 43 years since soil surveying began in this country, farming has become less an art and more of an applied science. As this process goes on, accurate soil information becomes increasingly necessary. On a modern detailed soil map of an average county the pattern of some 75 to 150 individual soil types and phases is shown accurately, and a large amount of information about them, about the natural vegetation and the crops to which they are adapted, and how the soils respond to different management practices is condensed in a 100- to 200-page accompanying text.

Each soil type or other unit shown on the soil map is defined by a large number of characteristics, including the character of the parent rock material, relief, and stoniness, as well as the thickness, texture, structure, color, acidity, content of organic matter or soluble salts, and other significant characteristics of the several layers or horizons that make up the soil profile. No one characteristic makes a soil of a certain kind

but several taken together define a soil type. The significance of a difference in any one of the soil characteristics depends upon the others in the whole combination. There are soils where a small difference in slope, in structure, in degree of erosion, or in acidity, for example, may be of great significance; whereas in other soils such differences, or even greater ones, may not be significant. Thus, the significant soil characteristics must be not only observed, but also evaluated in reference to the total combination in order to develop a useful classification. Maps can be made showing single soil characteristics, but these are not soil maps since the problem of classification has been avoided and left to the user. Further, soil classifications must be made with an eye to the future and not simply on the basis of a few superficial features important at the moment, else the maps will soon be out of date and unusable as crops and farming practices change.

Never before have soil maps been in such great demand or their use more necessary to national welfare. Farmers must increase production of some crops they are growing and must produce, in many instances, crops that are new to them. If the delays and failures of trial-and-error, as well as waste of soil and labor, are to be avoided they must be able to apply the experience of other farmers and of research to their own soils. They need to know what soils they have, accurately, and know to what practices they respond, and to what crops they are adapted. To fulfill this need is the fundamental purpose of soil maps and reports. During the past year, emphasis has been given to the soil requirements of crops, particularly critical in the war effort. Soil scientists have been engaged in determining the suitability of soil types and their distribution in connection with the expansion of such war crops as hemp for fiber, guayule, kok-saghyz, and goldenrod for natural rubber, peanuts and castor beans for oil, and milkweed for floss.

Soil maps have many other uses besides individual farm and community planning for secure production. They serve as a basis for rural land classification and for land appraisal. They are used to guide other agricultural research and extension programs. In fact, the modern soil map and report is aimed to be a relatively complete handbook of agricultural geography and land use for the area it covers. Soil maps have many engineering uses. People working in the various fields of biology and nutrition are continually finding new and important relationships between soil types and animal and human welfare.

Our Changing Geography*

Dr. Parnell W. Picklesimer, East Carolina Teachers College

THIS is a period in which great changes are taking place. This is notably true with respect to geography and its bearing on the present war. It is primarily the function of geography to assist in educating people to better ways of living. But this field of knowledge has been rather slow in rising to its rightful position of prominence in the school curriculum. This is partially evidenced by the fact that there are still a good many people living in the United States who believe the earth to be flat. Moreover, Dr. John W. Studebaker, United States Commissioner of Education, says: " . . . aside from rather backward nations, we are more illiterate geographically than any civilized nation I know." The question naturally arises, Why such a condition? Geography is not rationed and, if it has a contribution to make to American education, its assets must not be allowed to freeze. It is only recently that educational leaders have become somewhat alarmed at the geographical backwardness of our people. Now they call for more and better instruction in the science. Both teachers of geography and curriculum makers are charged with the responsibility of answering this call. The time has come when a young man or young woman cannot move with ease among groups of cultivated people without a knowledge of geography. Unfortunately, the present supply of adequately trained geography teachers for civilians is temporarily limited. Within the last 2 years our colleges and universities have lost many of their geography teachers—individuals who have been inducted into the armed services of the country because of the rising need for their specialized skills. Into the federal bureaus and departments in Washington alone have gone some two hundred of these people to assist in the war effort. Geography is today one of the priorities in education and, as a field of usable information, is becoming more and more subservient to the state. But the geographer is no crusader on a white horse; the facts and relationships of his science are clear-cut, and are available for human consumption. As a people, we have no other alternative but to learn and accept them. To some people such a statement may appear to be carelessly made, but it will withstand close scrutiny.

Geography in the Air Age

We have too long had the feeling of smug security in our democratic

* Reprinted through the courtesy of The Journal of Geography, October, 1943.

way of life. We have been reluctant to admit that isolationism as an American issue is dead. It is necessary that we keep our approach to each new era of study fresh and vital. Now, as never before, it becomes essential that students gain a global concept of the earth; that they understand fully the meaning of "great circle routes" and something of the distances between cities and continents. We are now living in an air age and, while our age has not matured, it is growing rapidly. Our people must be trained to think in terms of this age. As a people we run about a great deal, yet many of us have difficulty in intelligently interpreting maps, or finding the shortest distance to our fighting fronts. Most people are probably unaware of the fact that the shortest distance to many of our far-flung battlefronts is by way of the Arctic. In fact, until recently the ice of the Arctic regions barred direct or great circle transportation. The newer routes will not only be shorter but will often reach parts of the world which have valuable resources accessible only to the airplane. In Columbus' day 3 months time was required to cross the Atlantic, but only recently the journey was made by plane in slightly more than 6 hours. The indications are that air lines will soon bring all the world within a day's travel. Although the plane is of great value in waging war, it is to a large extent revolutionizing transportation of people and high valued cargoes. It is interesting to compare routes used for travel by air with those used for ocean travel. For example, the shortest air route from New York to Darwin, Australia, passes through Alaska. Seattle is a way station on the shortest route from the Panama Canal to Tokyo, and Denver lies very close to this route. The air route from New York to Rio de Janeiro is only 4,750 miles. The saving in distance between these points by air as compared to ocean routes may be easily visualized through a few simple measurements on a good globe. The establishment of air routes, the location of great landing fields, and the character of cargoes are all problems of the new air-age geography.

Geographical Study Stimulated by War

Every citizen is now interested in maps and descriptions of remote and little known places that have suddenly become of strategic importance to a world at war. When our armed forces invaded North Africa they took with them 110 tons of maps. They found this amount to be inadequate and sent back for 400 tons more. There is also a rising curiosity about geographical knowledge on all our fighting fronts. Do you realize that, strategically, Tunisia is more European than Africa; that North Africa is not a region of drifting sand dunes; that floods occur there so excessive as to destroy human life and property; and that there are cities two or three times as large as any in North Carolina? Do you further

realize that in this same region winter is the season of green and growing vegetation, and that the climate is similar to that of California, where many of our people go for their health and for retirement during their declining years? Do you know that Attu Island, within a few hundred miles of Japan, is the "source" of weather variations in the North Pacific; that the Japanese, by taking the island, knew not only what the weather conditions were there but what they were going to become in all the Aleutians, while the westbound Americans did not? From this factor alone Attu is of great strategic importance to America.

It is unfortunate that a World War is required to awaken the American press suddenly to a realization that maps can illuminate the events of the day in a more effective way than any other single mode of expressing environmental relations. Place geography, in some respects, is more important now than ever before. Such names as Guadalcanal, Coral Sea, Casablanca, Dutch Harbor, Attu, and Pantelleria were unfamiliar to most people before our entrance to World War II. The exigencies of war resulted in the construction of the Burma Road and the Alaska Military Highway, as well as many other less publicized roads. Airplanes are delivered to battlefronts by being flown to England, to Egypt via South America and the Sudan, to Australia and even to India and China. In emergencies thousands of troops, together with their equipment, have been delivered quickly by air. This was admirably demonstrated by the Allies in their final attack on the Axis forces in Tunisia. But geography is much more than a study of location, distance, and space. In time of war it is important to understand the strength and weaknesses of the enemy and the apparent reasons for attack. Geography involves also a study of land forms, especially configuration of the coasts, and the climatic variables. It includes a knowledge of population, together with the training and capacities of peoples; a knowledge of their food supplies and food potentialities; and information concerning the sources of minerals and other critical raw materials. The Axis forces were able to forge ahead across the plains of Russia, but were slowed up and held in check in the Caucasus Mountains. The British Eighth Army chased Rommel a thousand miles across the plains of Africa, but the final victory was delayed when mountainous territories were encountered. Each time enemy warships find shelter in the protected fjords of Norway we sense anew the importance of land reliefs. Enemy seizure of blankets in Norway and food supplies from the people of Denmark, Holland, France, and the starving Greeks; the fight for oil and rubber; and the rationing of food in America all bring home to us the importance of agricultural and other raw materials. Thus remarkable changes in trade and industries have come both to our own country and abroad as a result

of the occupation of lands by aggressor nations and the necessity for defense programs. America's total defense participation in the present global war constitutes in itself a most convincing argument for the need of an intensive program of geographic education.

Changes in Industry

Today the geographer observes the changing industrial map of America. And along with it come changes in business control—for the government owns most of the new factories. The federal stake in industry now amounts to some $14,000,000,000. These projects, for example, produce more aluminum that all the private companies put together. The Defense Plant Corporation of the Government has built and equipped 1,022 plants in forty-three states, and is building 457 more. This agency works like a mammoth bank, producing airplanes, arms and ammunition, radio and communication equipment, machine tools, ships and ship parts, iron and steel, synthetic rubber, etc. Private industry is, for the time being, greatly overshadowed by the Government's efforts to meet the emergencies imposed by war. Along with this change, the scourge of unemployment has been completely wiped out.

Influences of Science and Technology

Much has been said of man's conquest in industry and war through developments in science and technology. In 2 years a great synthetic rubber industry has been built that probably would not have been set up in half a century of peace. War's plastic achievements are numerous. Already more than two hundred airplane parts are being made from plastics. The shortage in quinine is being met by the discovery and development of synthetic substitutes. In most cases the war has been the great stimulator.

Today the aerial camera ranks in importance with the tank in changing the tactics of modern warfare. Hours before our bombers raid Axis centers planes equipped with the latest photographic devices cover the area to be bombed. Pieced together on a large map the pictures taken dictate the route our bombers shall travel, the speed and altitude to be maintained, and the size and number of bombs to be carried to the enemy. Photographs are often taken through thick fog on the darkest of nights. They detect the clever camouflage schemes and reveal the height of buildings or the depth of a trench—accurate to within a tenth of a foot—from altitudes as great as 37,000 feet. We are told that the best photographic effects can be secured after sundown, and these are not limited to the black and white types only. After the pictures have been taken, devel-

oped aboard the airplane on the return trip, they are immediately turned over to other technicians who plan and direct the bombing expeditions. This type of procedure saves much time and loss of materials and equipment, and enables bombers to drop their cargoes of destruction directly upon the target.

From a strategical standpoint, our armed forces have also been enriched by the invention and development of *radar,* a weapon that is only second in importance to the airplane in waging war. The public is not in possession of all its secrets. Many of its critical facts are securely locked in files. In brief, radar appears to be similar to a searchlight, the beams of which are not illuminated. These beams scan the sky and sea with sharply focused ultra-high-frequency radio waves. When these waves strike an object they are reflected. The distance is determined by the length of time required for the rebound, and the object can then be "seen" by means of a radio receiver which is carefully and properly tuned to pick up the reflected signal. Radar has been used against the enemy for many months, and is probably more responsible than any other single factor for saving England when its people were almost beaten to their knees by the German Luftwaffe. The press reported that British pilots and gunners were being fed carrots to improve their vision, but the truth of the matter is that radar was being used to detect the German raiders almost as soon as they left their bases. When the Germans arrived they found the Royal Air Force aloft and waiting for them. A radar instrument can detect not only the presence of an enemy plane or ship but can also determine its direction and distance. The instrument can be made to accomplish these feats in total darkness with the speed of light, and enable gunners to aim accurately and shoot down enemy planes above the clouds. Thru the medium of this detective device naval guns can accurately place their shells on the deck of an invisible ship at sea, or engage in successful combat in total darkness. Radar has played a far more important role on our battlefronts than most people are aware. Radar apparatus in general, however, is classed as a military secret.

Geography Not Static

Geography is not a static science. In a changing world some centers will take on a new importance while others may become less important. For example, Kimberley, of South African diamond fame, has become a ghost town as men have gone from the mines to serve with the armed forces. The diamond cutting centers of the low countries of Western Europe have recently relegated first place to New York City. Today the Argentine railroads are being compelled to use corn mixed with coal for fuel. At present there are more windmills in England than in

Holland. Some years ago the Chicago River was turned around and made to flow in the opposite direction. In general, the passing years bring changes in the demand for particular commodities, and these changes are reflected in the expansion and contraction of producing areas. New machines and processes upset the established order and usher in new ones. Such changes, however, must work within the limits imposed by the natural environment.

The Outlook

There is no doubt of the rising interest in geography. The process has been slow, but time will gradually clarify its findings, correct its errors, and consolidate its positions. Conclusions already reached are beginning most hopefully to redirect education. A new concept concerning the field and function of geography is gradually developing in the minds of an increasingly large number of people. In time we shall doubtless, and probably at great cost, learn to use our gradually accumulating experience in wiser ways for a finer good.

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"WET-STRENGTH" PAPER

A short time ago it became necessary to ship potatoes to market in paper bags because of the need of conserving burlap and other packaging materials. When some of the farmers first heard of this idea they were skeptical and quite sure it wouldn't work. But they hadn't yet heard about "wet-strength" papers, whose commercial development and application had been accelerated by the use of a new process and the pressing demands of war.

The new bags soon demonstrated their worth. The result is that "wet-strength" papers are now being used not only for shipping vegetables whose moisture would cause bursting of ordinary paper, but also for wrapping meats and frozen foods and a number of other commodities for overseas shipment; for camouflage strips and nettings; for printing books and pamphlets used by the armed forces and subject to wetting in the field; and for maps, charts, and blueprint papers. It is even possible to make paper towels which can be used, rinsed, dried, and used again.

One of the latest processes in this development of paper having a high strength when wet consists of incorporating an acid solution of a synthetic resin, known as melamine, with the paper pulp in the beater before the sheet is made. The treated pulp is made into a sheet in the customary manner on regular paper-making machines without modification of either the machine or the method of operation. The colloidal resin particles, which have a positive electrical charge, attach themselves to the negatively charged cellulose fibers of the paper and form such a close bond that they cannot be washed free. It is this hold on the fibers that subsequently gives the paper its high strength and resistance to rubbing when wet.—*The Scientific American*, October, 1943.

Everlasting Boundaries*

PROF. A. H. HOLT, The State University of Iowa

ONE source of considerable trouble to land owners, deed writers, and abstracters is the difficulty of adequately describing parcels of land, so that another person may determine, perhaps some years later, how the boundaries thus described are related to the stated boundaries of adjoining tracts, and so that these boundaries may with certainty be retraced on the ground when physical evidences of original lines have disappeared.

METHODS OF BOUNDARY DESCRIPTIONS

Descriptions by sections and fractions of sections, or by block and lot numbers, obviate the former of the two difficulties named when such descriptions can be used. The solution is not so easy when the parcels are irregular. So-called "metes and bounds" descriptions are then commonly employed—describing the land by naming a starting point, and then giving in order the length and bearing of each of the bounding lines. The extreme improbability of the exact correspondence of two independent descriptions of the same lines, forming the common boundary between two adjacent tracts, often leads to uncertainty as to whether one description refers to the same boundary as the other, or whether there may be an overlap, or perhaps a gap between the two.

To make possible the retracing of a boundary is one of the most important functions of a description. Physical marks of boundary established upon the ground, and physical evidences of occupation and use, are ordinarily the best evidence of legal boundary. But sometimes, for one reason or another, these shift or are obliterated. To redetermine their former positions usually requires a survey. To one who has not had experience in conscientiously trying to "rerun" old boundary surveys, some of the difficulties involved in interpreting a description for this purpose may well be not at all apparent. He might, therefore, be led to accept a description which would prove to be quite useless if, with the physical evidence of the boundary obliterated, independent reliance had to be placed upon the description to locate the lines in the field.

A common impression seems to be that if a "starting point" is available, even though it is remote from the boundary to be located, a competent surveyor should have no uncertainty as to how to proceed, nor experience any real difficulty in running out the boundary from the

* Reprinted through the courtesy of the Iowa Law Review, November, 1935.

description. We are not, for the moment, concerned with the important fact that a proper re-running of the boundary description, if accomplished, would constitute merely one item of evidence as to where the boundary should now be. We are concerned only with an attempt to retrace the footsteps of the original surveyor. Assume even that the much-emphasized "starting point" is available. Assume, further, that the description is so complete that a competent draftsman (and the surveyor undoubtedly qualifies as such) could lay it out on his drawing board and get a closed polygon. These assumptions have taken us a long way on our road, and have passed over serious difficulties which are more often met than escaped; but they leave the most serious of all. As one reads the bearing of a course—N 10°-15′ E, for example—one receives no information as to whether that direction has reference to magnetic or to true north. Usually no explanatory statement accompanies the description. Nor would the problem be solved if it were known which of the two was used. One of the possible reference directions, magnetic north, is continually shifting, and in a very irregular manner. It is, therefore, very difficult to determine, from the stated magnetic bearing of a line at a past time, what bearing should be used to retrace the same line at the present time. If the bearing were accurately referred to true north, that would be quite satisfactory; but to do so astronomically would mean an expense which would be prohibitive for a small survey. Hence, this is rarely done. To refer to true north by means of the magnetic needle, as is commonly done, leaves the result little better than a magnetic bearing. The chances are that neither magnetic north nor true north was used, but that the direction of some section line—or of a fence supposed to be on a section line—was taken to be north, or east. Mention might be made of the fact that the writer has yet to find a section line which really runs north. This is not particularly surprising, however, in view of the fact that, contrary to popular impression, most of them were never intended to do so.

Also, if the starting point is described, as it frequently is, as being "560 feet north and 375 feet east of the southwest corner of section . . . ," the chances are very good that the uncertainty of direction existing when these terms are used would mean a very appreciable uncertainty as to the proper location of the point. Furthermore, if the section corner to which the position of this starting point was referred has been lost (not merely obliterated), so that no local physical evidence of its former position remains, the chances of anyone being able to establish a new point within several feet of the old corner, assuming that he carries out accurately and precisely the methods officially prescribed, are very remote indeed.

This last statement indicates that even if the description be by section and fraction of section instead of by metes and bounds, the loss of section corners may make practically impossible the determining of original boundaries. To a slightly lesser degree, the same situation obtains with reference to town property.

It is to be kept carefully in mind that we are not here discussing the whole subject of determination of legal boundaries, but merely the single matter of retracing where boundaries once were—which may or may not be where they are now.

All the foregoing merely recites some of the difficulties to be found in the present situation. Two questions naturally come immediately to one's mind: (1) If all this is true, how have we been able to get along these many years, and (2) is there an available, practicable remedy?

The first question can be answered by two statements: Lack of precision, or even of certainty, has not been so serious in the past, when land values were lower. Moreover, and most important, many, many things besides recorded descriptions help to perpetuate land boundaries.

The National Control Net

To indicate an answer to the second question is the purpose of this paper. A remedy now available is a means of stating the positions of points on boundaries, simply and with unmistakable certainty, and with such an interrelation throughout the system that if some points are missing the remaining ones may be effectively used as a means of re-establishing those which are lacking. It has long been in use in Massachusetts, and in scattered small areas, has been legalized in New Jersey; but it has come to be at all generally available only in the last few years. The present availability of this system of boundary control is due to a great impetus which has been given to long-needed control surveying, chiefly by or under the direction of the United States Coast and Geodetic Survey. This Survey establishes, with very high precision, the positions of rather widely separated points, called triangulation stations. This work is of a highly technical nature, and our present interest in it is merely to recognize that it furnishes an invaluable means of tying the local control of points to a national—in fact, international—system. Were it not for this extensive control, the local control system with which we are concerned would necessarily be practically isolated from other work at no great distance; and much of its usefulness and of its permanent character would be lost.

State Plane Coordinate Systems

Tied in to, and dependent upon, this triangulation system in a manner

with which we need not now be concerned, there has been established for each State, by the United States Coast and Geodetic Survey, a simple system for local control. For some states, and Iowa is one of these, two systems, distinct from each other, but interconnected by the triangulation mentioned, have been found necessary. This is because these systems are to furnish a means of describing the locations of points on the earth's surface with all necessary precision and at the same time, for the sake of simplicity, as though they were on a flat surface. Since the earth's surface is not flat, but curved, one such system cannot be extended too far without appreciable error.

The local use of each of these systems for the control of private boundaries is essentially as follows: Surveys are run by government agencies among the triangulation stations, establishing over the area in question monuments at sufficiently close intervals to make them practically and economically accessible for use in connection with the survey of a farm or of a city lot. Each of these monuments is a concrete post set firmly in the ground with its top nearly flush with the surface, and bearing a bronze disk, or tablet. On this disk is marked the exact point whose position is fixed by the monument, with sufficient wording to identify the monument and to warn against its disturbance. The position of each of these monuments is determined and published for general use. This position is stated in the simplest possible terms: one distance east, called the "X Coordinate," and one distance north, called the "Y Coordinate." These distances, or coordinates, are simply feet and decimals. The uncertainty described earlier in this paper concerning the meaning of the terms "north" and "east" does not exist here. For example, if the coordinates of point A are X=5,000 feet, Y=9,000 feet, and of point B, X=5,020 feet, Y=10,000 feet, a point 20 feet west of B will be due north of A and 1,000 feet distant therefrom. The direction and distance of B from A may, of course, be easily calculated. Thus, any two of the monuments mentioned above, or any two other points which have been tied into the system, furnish the means, if they are intervisible, of determining the direction of north.

Simplicity in Use of Plane Coordinates

With two such points, preferably two reference monuments, available in the vicinity of any tract of land whose description is required, only the simplest work of plane surveying, familiar to every engineer, is necessary to ascertain the "coordinates" of the points whose positions determine the boundaries of the tract—the corners. These coordinates fix the positions of these points for all time. This is true because as long as any two of the local control monuments remain, simple surveying

operations will serve to locate on the ground a point of any given coordinates. In the very improbable event of the local monuments being all destroyed, surveys from the triangulation stations would serve to establish others—not necessarily in the same places—which could be used for the same purposes as those which had been destroyed. Indeed, it would be entirely possible to extend this process from remote triangulation stations if nearby ones were lost—all without loss of precision or certainty.

This is in no sense true of the system of public land surveys—nor indeed of any survey or system not a part of the national control net.

One point deserves special emphasis, viz.: that in the use of this control there is no superseding of current methods of surveying, no abandonment or modification in any way of the public land system of subdivision, or of the use of it in describing parcels of land by sections and fractions of sections. It is a means of more usefully and more effectively recording the locations of points on boundaries, whatever they are or however they are determined. Moreover, the use of it enables one to ascertain easily and positively whether two descriptions supposed to refer to the same lines (a common boundary of two adjoining tracts) do actually coincide. And it gives assurance that, once tied in, a boundary marker can be found at any time in the future if it is still in existence; and if it is not, the place where it stood can be located.

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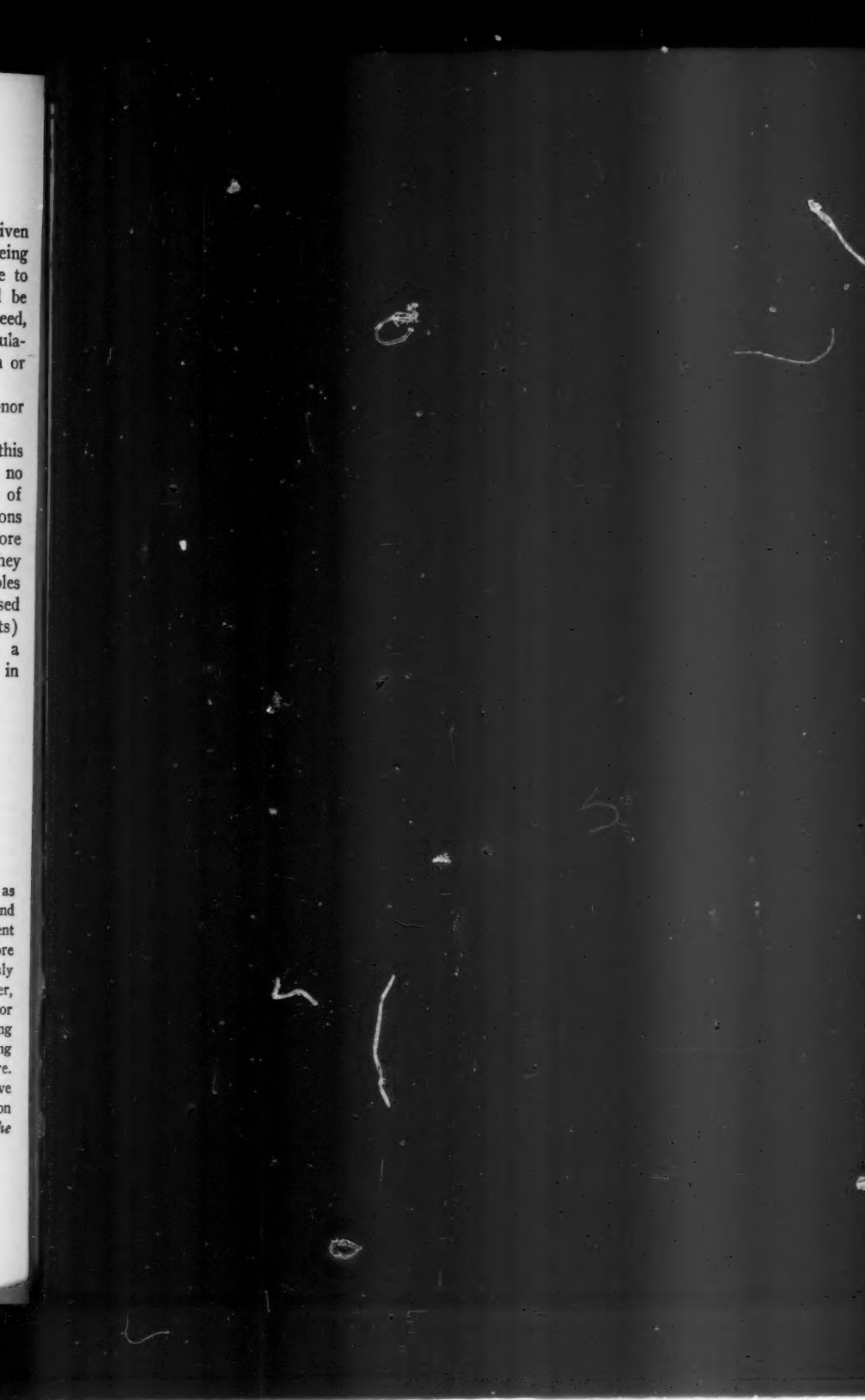
INSTRUMENTS IN THE DICTIONARY

IN its earlier impressions the 'Concise Oxford Dictionary' defined the theodolite as a surveying instrument for measuring horizontal and non-vertical angles, and one may wonder how the definition got so peculiarly wrong. A much more recent work, the 'Shorter Oxford English Dictionary,' 1933, in two volumes, is more picturesquely misleading. The theodolite is an instrument "subsequently variously elaborated with a telescope instead of sights, a compass, level, vernier, micrometer, and other accessories, and now often with the addition of a vertical circle or arc for the measurement of angles of altitude or depression." The plane-table is a surveying instrument used for measuring angles in mapping, consisting of a circular drawing table mounted horizontally on a tripod, and having an alidade pivoted over its centre. An examinee asked to discuss the errors in the preceding statements would have plenty to say; but it would be hardly fair to ask him about the Oblique Ascension of a star, for he will hardly find the term elsewhere than in that dictionary.—*The Geographical Journal* (London), August 1943.